



Success Stories with Distributed Object Computing: TeleMed

David Forslund

Los Alamos National Laboratory

Object World

Boston, Massachusetts

May, 1996



Why new technology is needed in healthcare

- **Computerized Patient Records are in demand**
- **Wide area access of distributed patient data could improve quality of healthcare and reduce costs**
- **Healthcare needs to leverage off of widespread information technology**
- **Open extensible systems are crucial to accommodate changing environment**
- **Requirement for linking heterogeneous systems**
- **Software costs need to be reduced**



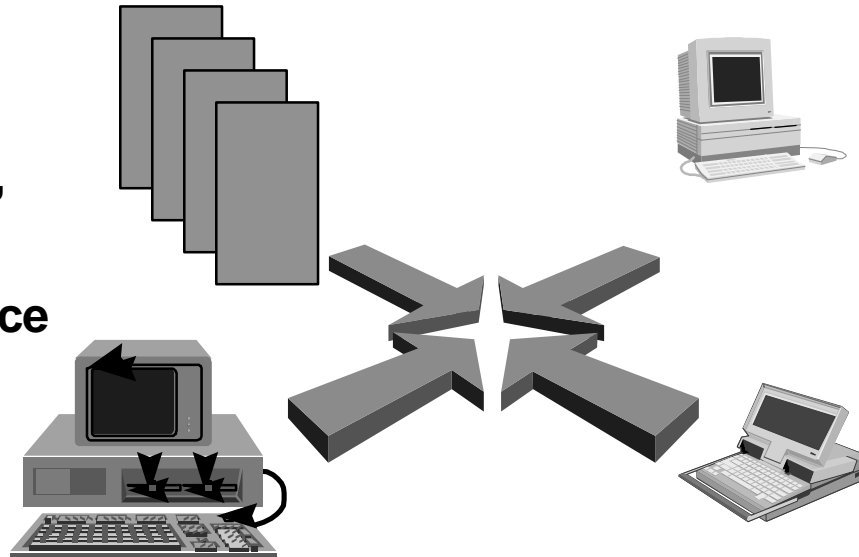
TeleMed: An Integrated Approach to the NII

- **Build on HPCC strengths at LANL**
 - Develop HPCC as a commodity service
- **Use real applications to define infrastructure**
- **Design reusable components that span many disciplines:**
 - e.g., CFD simulation to telemedicine
 - data-mining is common to wide variety of problems
- **Use industrial standard, interoperable components wherever possible**
- **Build on network which provides high-bandwidth, multimedia for the future**
- **Live with existing bandwidth when necessary**



The Problem of Integrating Applications

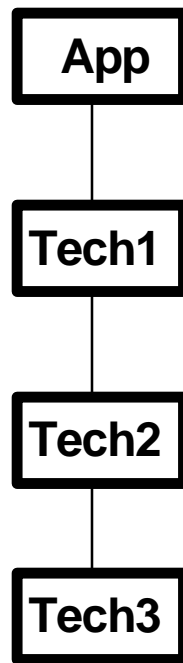
- *Application Integration* and *Distributed Processing* are the same thing:
- Constructing information-sharing distributed systems from diverse sources:
 - ☐ heterogeneous,
 - ☐ networked,
 - ☐ physically disparate,
 - ☐ multi-vendor.
 - ☐ disparate performance





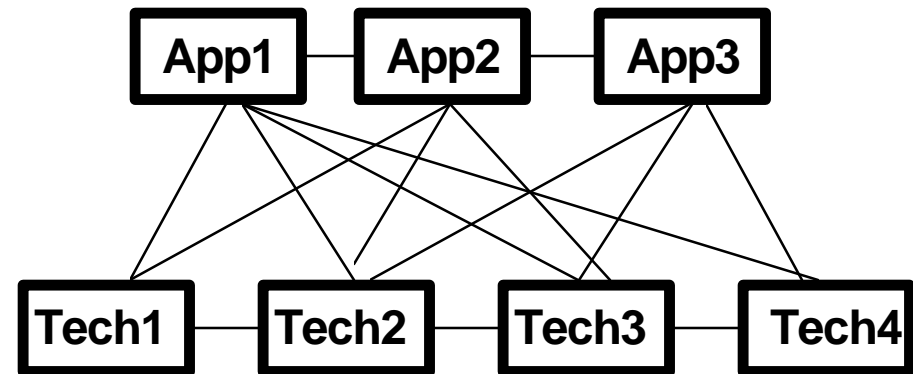
TeleMed Approach

Vertical Integration



- Efficient for given domain
- Not always scaleable

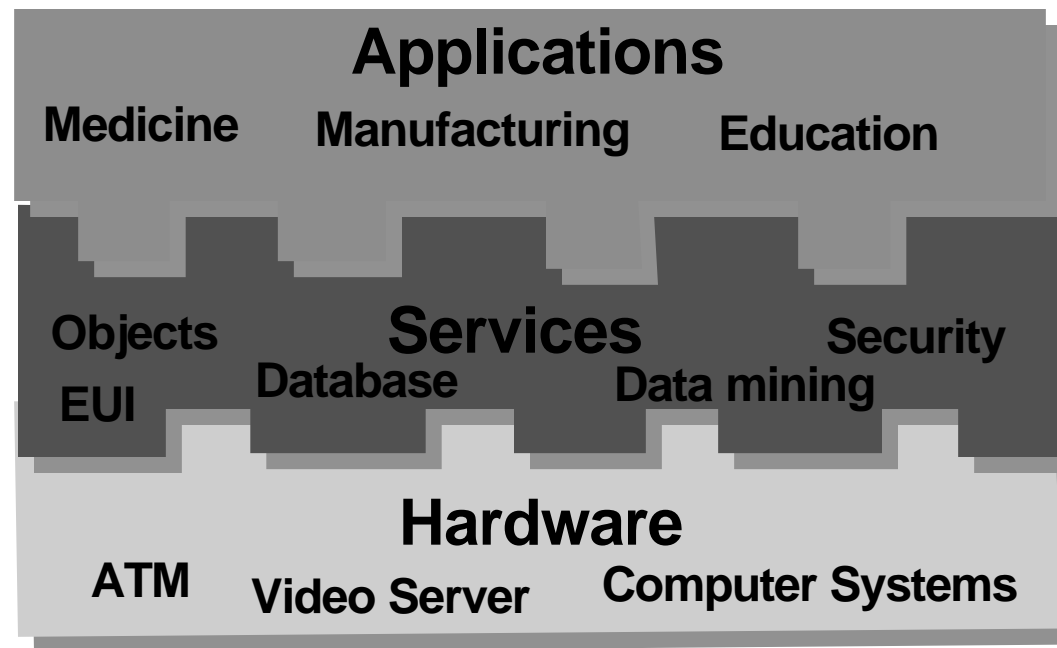
Horizontal Integration



- Common tools identified
- Infrastructure clearly delineated
- Scaleable solutions



TeleMed uses an Integrated, Layered structure





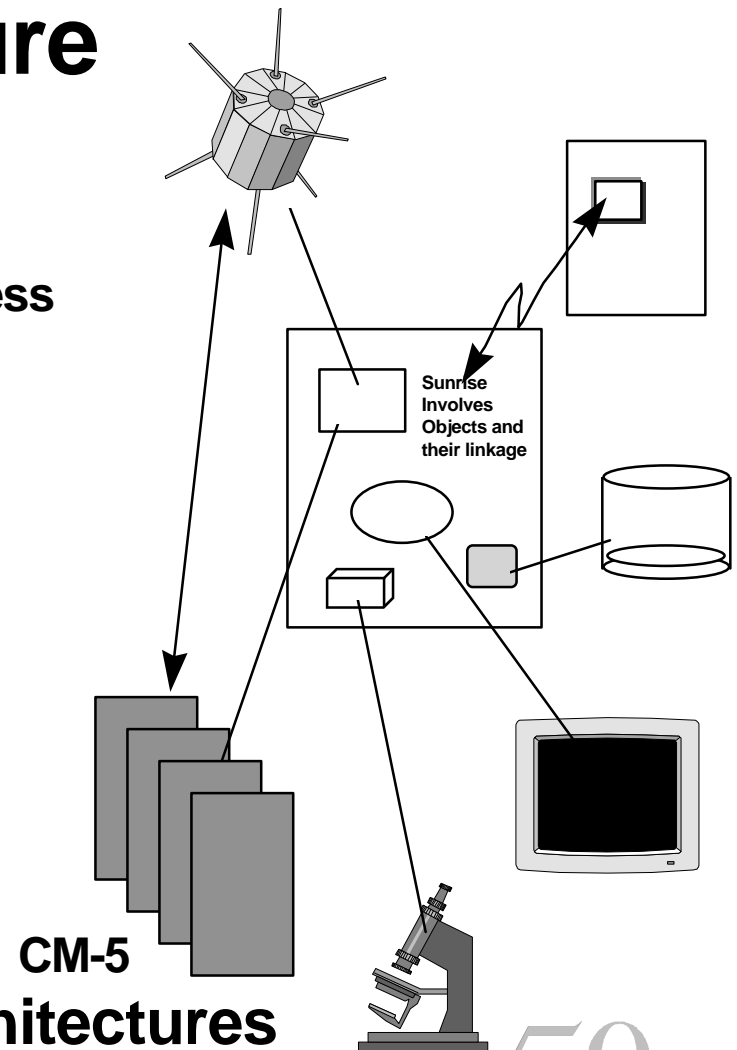
Integration Infrastructure

- **Distributed Object Computing**
- **User Interface and Telecollaboration**
- **Data Analysis and Visualization**
- **Data Mining**
- **ATM Networking**
- **Security**



Reusable, Extensible Infrastructure

- **Distributed Object System**
 - Dynamic, hierarchical, desktop access
- **Document interface**
 - Nested, remote objects
 - Extensible
 - Heterogeneous platform support
 - Can link to scientific application
- **Multimedia support (ATM)**
- **Security for each object**
- **Telecollaboration**
- **Spans multiple hardware architectures**





User Interface and Telecollaboration

- **Need for a media-rich flexible user interface that can provide the information in an intuitive and extensible manner**
- **Support for video, sound, and distributed data sources required**
- **Gain Momentum has been used because of its flexible, object-oriented support of multimedia.**
- **An executive user interface for computerized patient records has been developed**
- **Java ORB integration is also being developed**



Security

- **Goal: Provide capability for authentication and authorization to view distributed data**
- **Secure data at object level, allow policy to drive security deployment**
- **Developed Kerberos-like public-key based key and ticket server system for use with CORBA**
- **Developed a scheme to secure remote C++ method calls in CORBA applications**



Data Mining

- **Large data sets need computational assistance for analysis**
- **General concept extraction techniques including**
 - image comparison and matching
 - multi-dimensional cluster analysis
 - wavelet transform for variable granularity display
 - multi-dimensional database navigation
- **Deliver these technologies in a usable, scaleable environment**



Medical Information

- **The National Information Infrastructure (NII) will have a profound effect on the way in which medical data is utilized.**
- **A patient's medical history be immediately available to a physician anywhere in the country within seconds, and this history contains**
 - text (physician notes from every office visit),
 - numerical data (height, weight, blood pressure),
 - digitally recorded signals (erratic heart sounds, EKG traces),
 - and digital imagery (photographs, x-rays, MRI scans).



TeleMed

- **We have developed a prototype software environment for a physician**
 - relevant information is available and easily manipulated.
 - displays and analyze imagery,
 - manage patient records,
 - provide easy data entry,
- **Transparent access to information located anywhere on the massive *information superhighway* will give doctors great flexibility in their work**



Utilize Distributed Architecture to Aid Healthcare

- Provide rapid access to full patient record
 - Virtual Patient Record
- Compare to treatment of similar patients
- Allow remote doctors to view and collaborate on patient record
- Powerful tool in saving physician time and providing more precise diagnosis and clinical analysis
- Allow stewardship to reside with authors of information

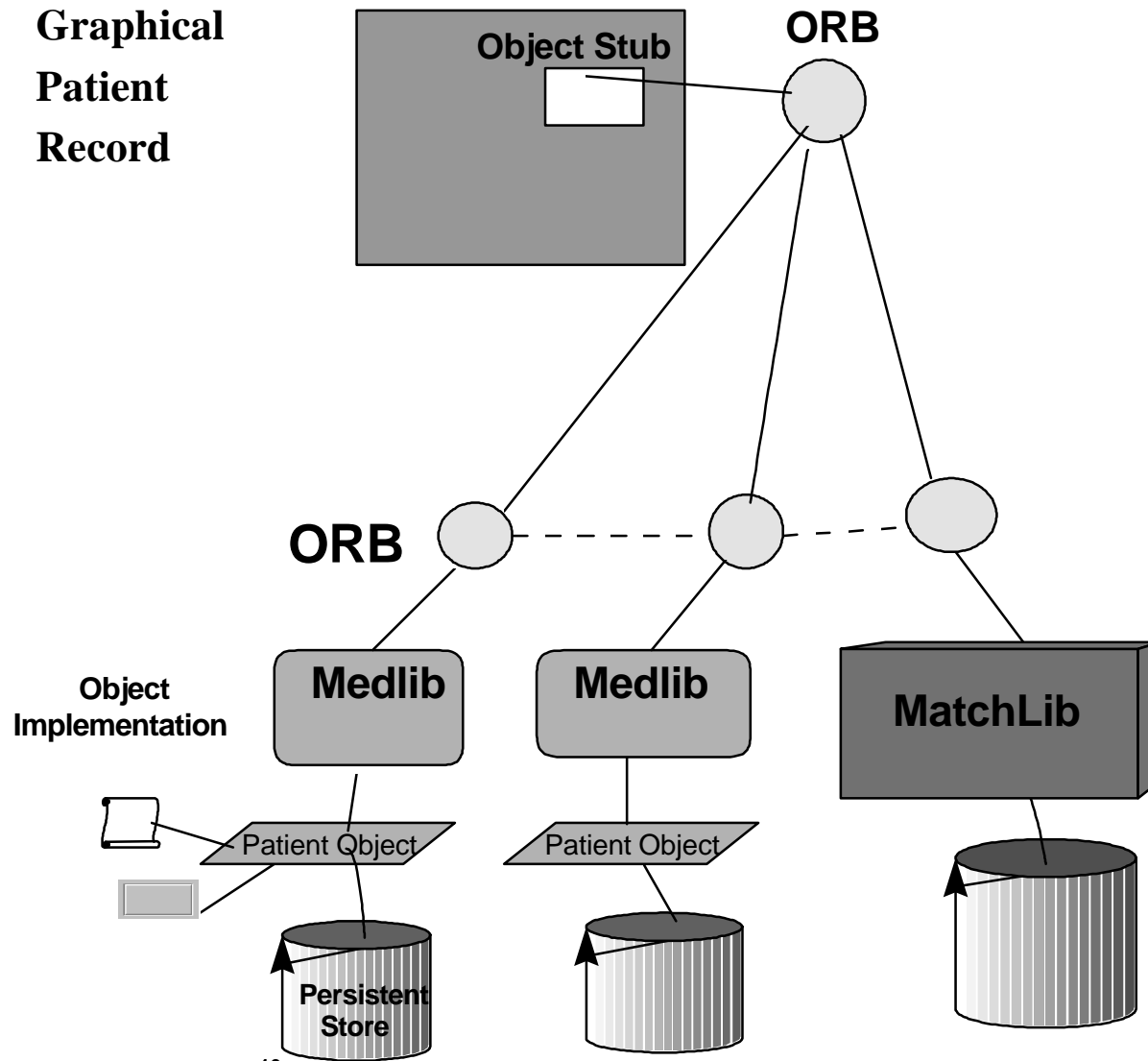


TeleMed is built on Open Distributed Object Technology

- **CORBA/ORB's for communicating between systems**
- **Multimedia graphical interface including audio**
- **Patient data stored in multiple OODBMS's**
- **Scalable concept extraction techniques**
- **Object level security and authentication**
- **All objects are fully distributed**

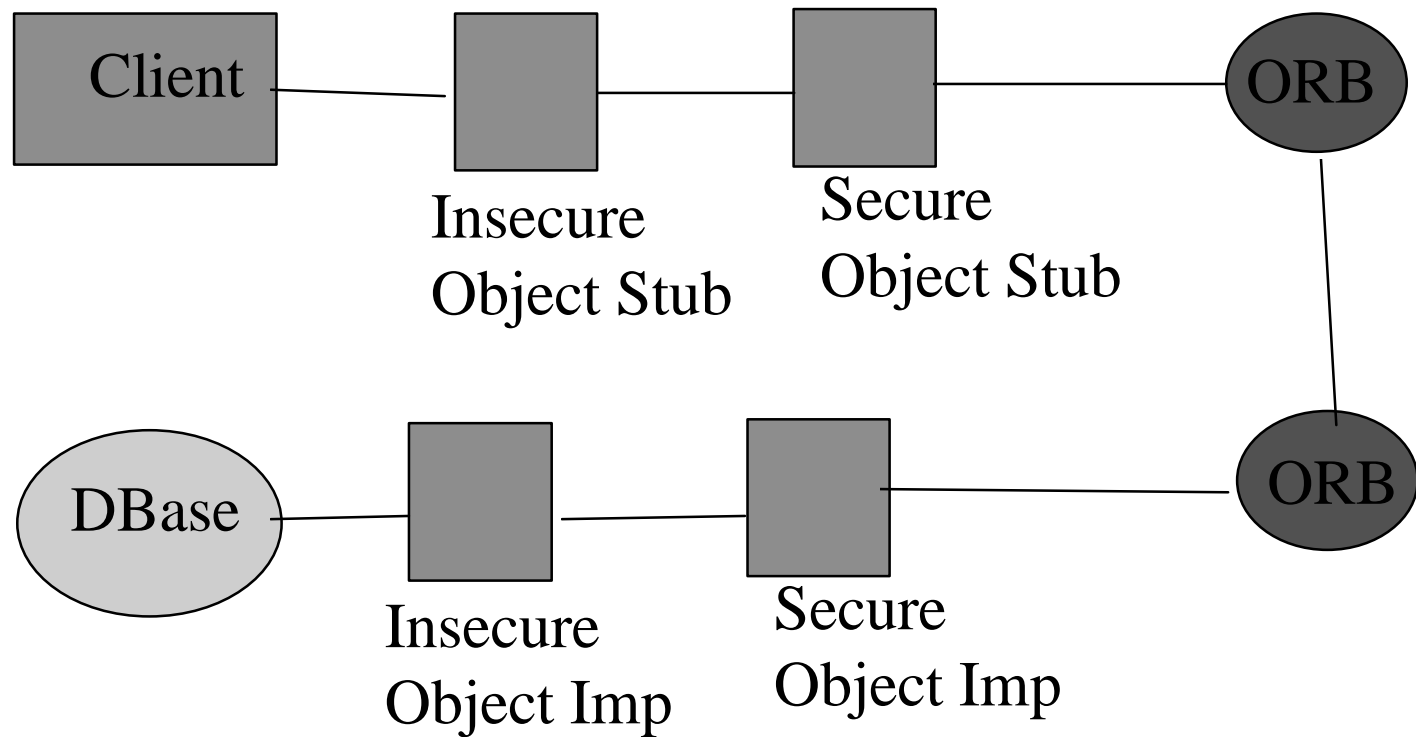


TeleMed Architecture



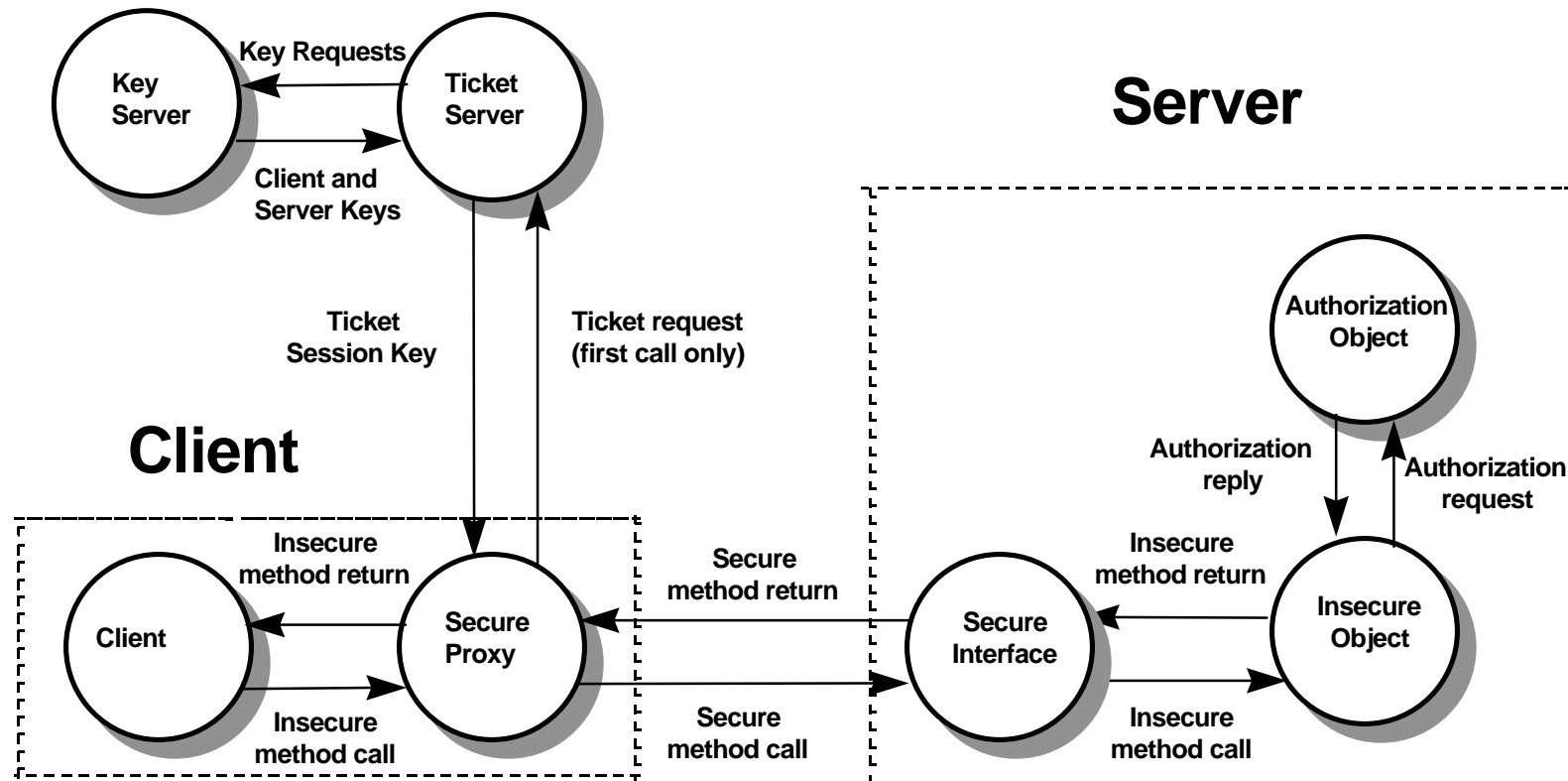


Security in TeleMed



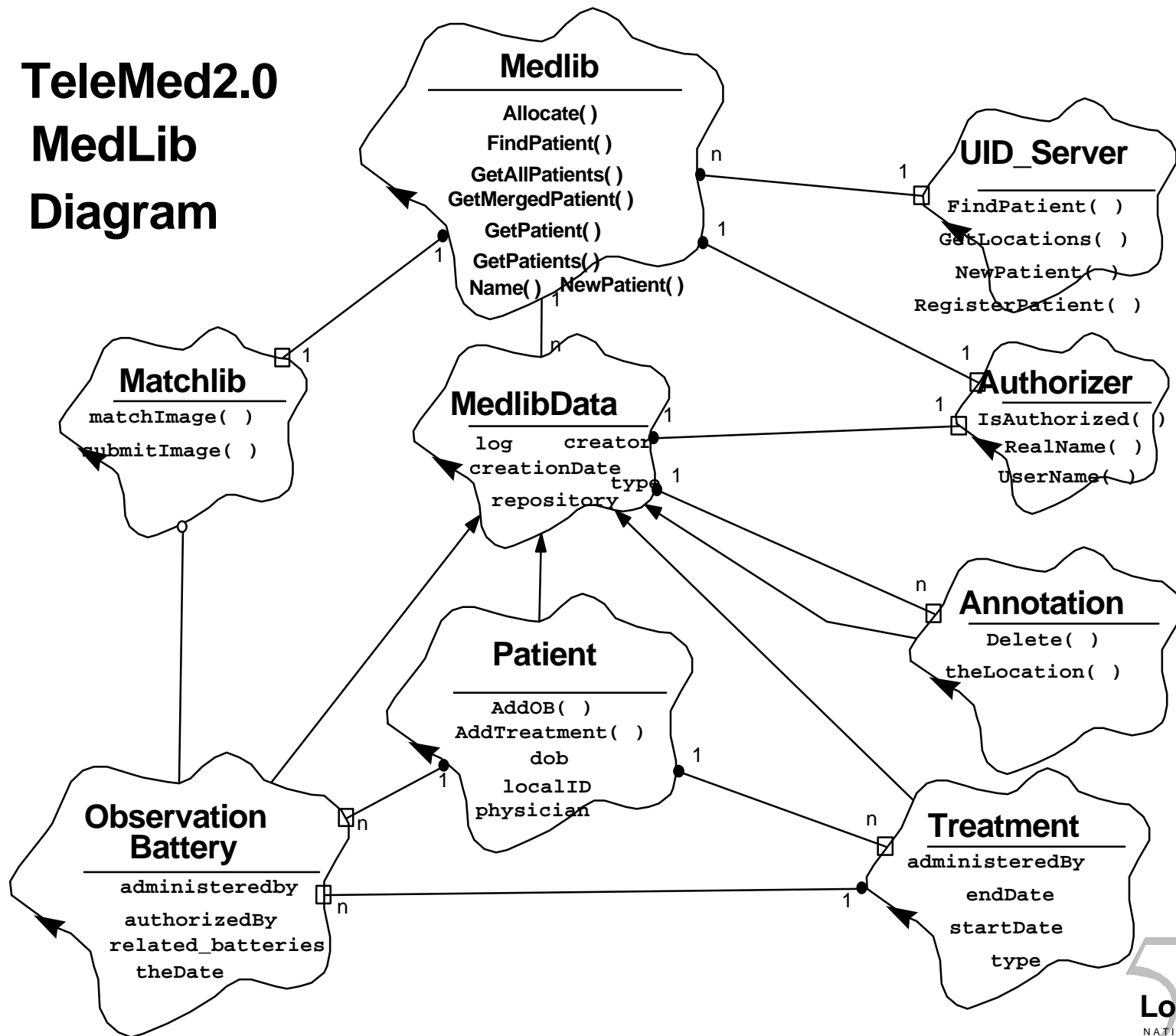


TeleMed Security Infrastructure



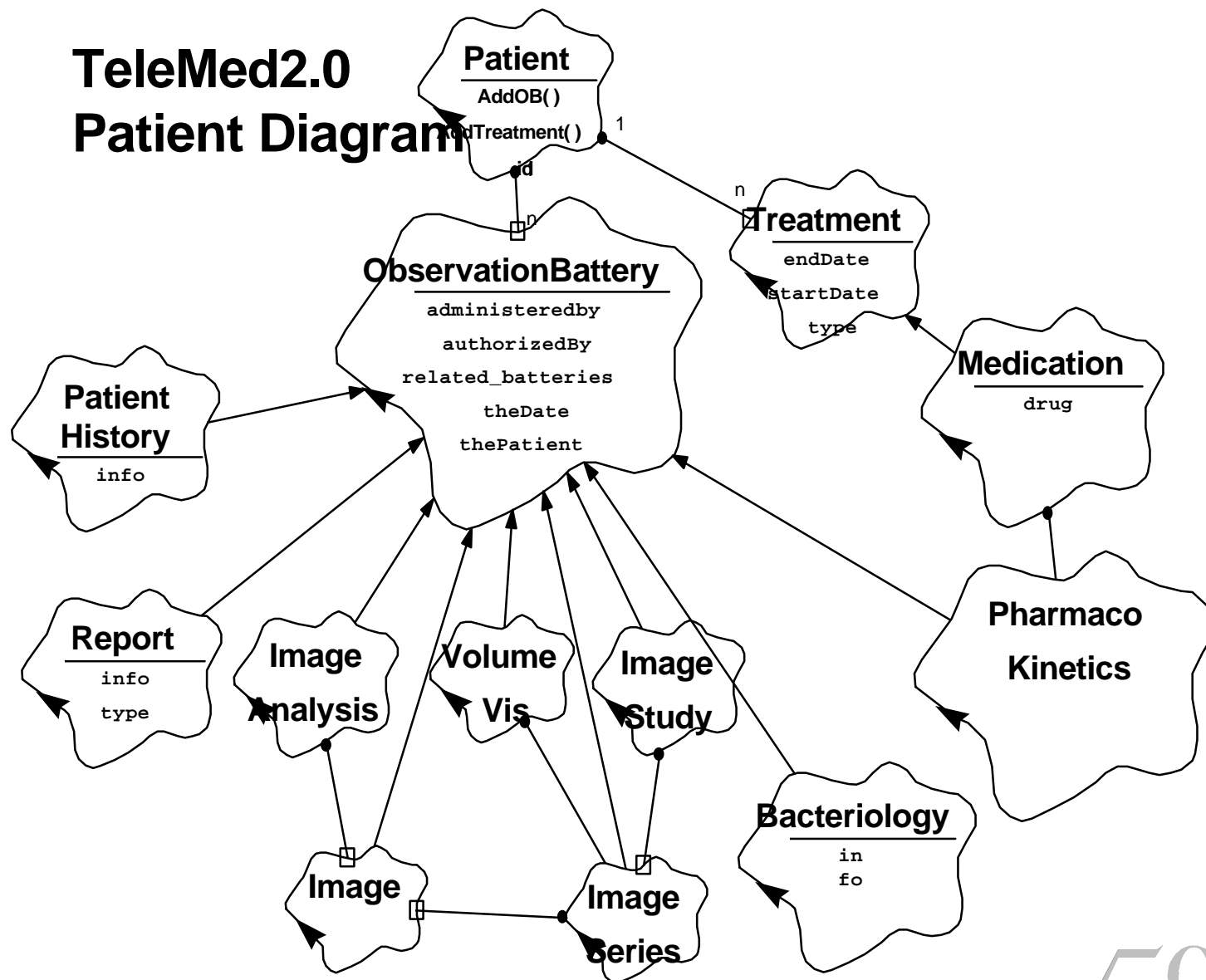


TeleMed2.0 MedLib Diagram



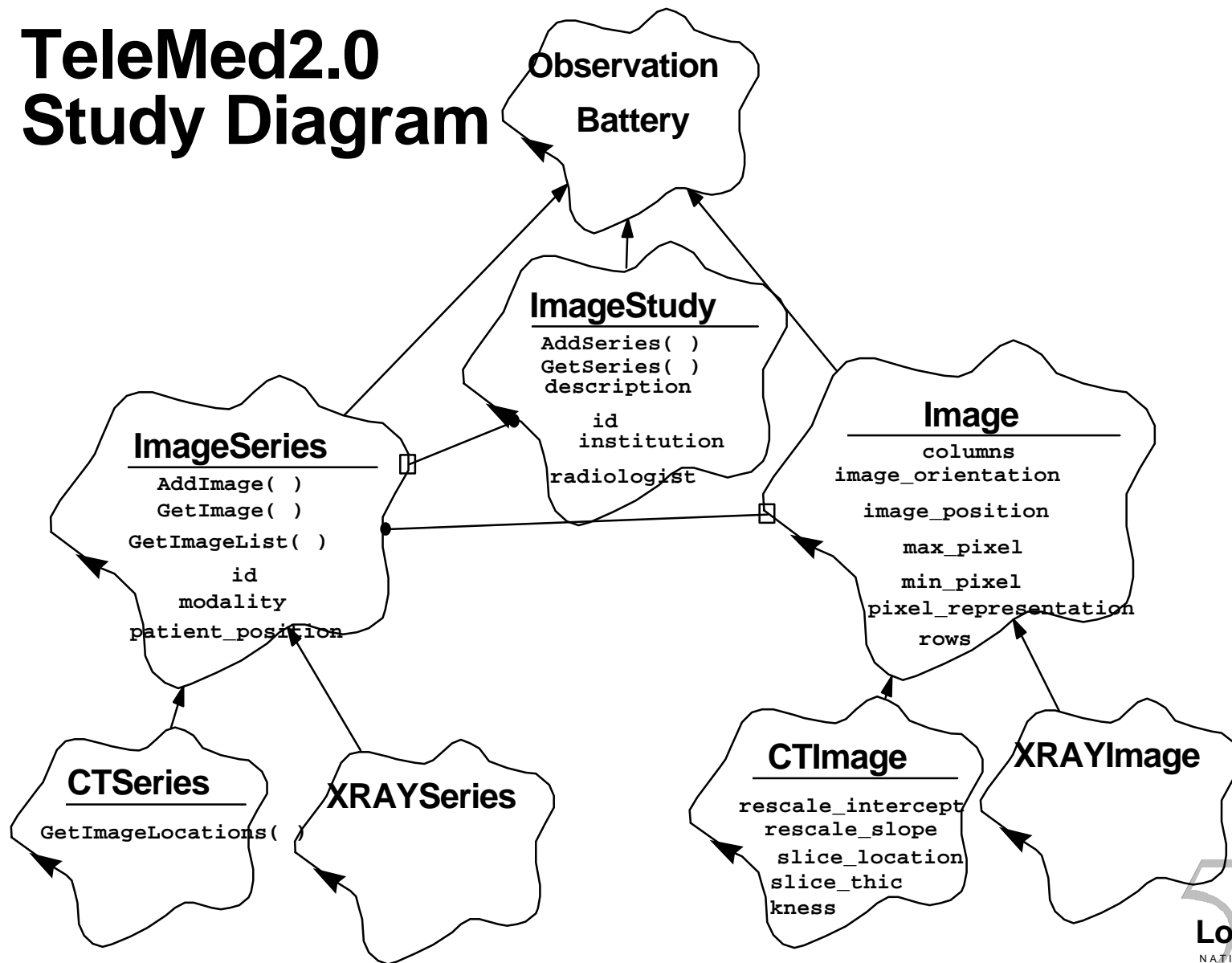


TeleMed2.0 Patient Diagram





TeleMed2.0 Study Diagram





TeleMed Emphasizes Technology Reuse

- **Image Browsing tools**
 - Feature extraction works for materials, medical images, financial data, transportation networks
 - Extension of feature extraction to other domains
- **Standardized base objects**
 - Common elements such as signatures, image, embeddability
 - Portable across systems and storage technologies
- **Navigation tools**
 - Location finding, object name resolution, network display
 - Log books, secure time stamps
- **Digital video might be computer output or instrument output**
 - Data fusion combines different types of data



Significant Results from TeleMed

- **Powerful intuitive interface**
 - Easy access to any patient data
 - Entire treatment history visible (collects all relevant factors for proper management of disease)
- **Ability to reduce treatment costs and improve patient care**
- **Integration of multimedia data from a variety of sources is useful in many applications**
- **Data mining techniques can be used by non-technical users**
- **Truly practical use of distributed HPC.**



Sunrise/TeleMed Team

- David Forslund, PI
- Dick Phillips, chief architect
- Jim Cook, John Newell, Physicians NJC
- Bob Tomlinson, Distributed Computing
- Jonathan Greenfield, Security
- Pat Kelly, Data Mining (CANDID)
- Al McPherson, Visualization
- Jonathan Bradley, Compression
- Steve Tenbrink, Networking
- Mohamad Ijadi, Dave Kilman Software integration
- Juhnyoung Lee, Francisco Reverbel: OO Databases
- Jim George, system deployment